STUDIES ON BOREAL AGROMYZIDAE (DIPTERA). II.
PHYTOMYZA MINERS ON *SENECIO*, *PETASITES* AND *TUSSILAGO* (COMPOSITAE, SENECIONEAE)

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Twelve species of Phytomyza *are known as miners of* Senecio, Petasites *and* Tussilago *in boreal areas. These belong to three species-groups, the* albiceps *group (4 species), the* syngenesiae *group (3 species) and the* robustella *group (5 species). Three new species of the* robustella *group are described, as follows:* Phytomyza hyperborea *n. sp. (type-locality Walker Fork, Alaska),* P. hypophylla *n. sp. (type-locality Eagle Summit, Alaska) and* P. lugentis *n. sp. (type-locality Summit Lake Pass, British Columbia). In the* albiceps *group one new subspecies is described,* Phytomyza tussilaginis kevani *n. ssp. (type-locality Richards Island, Northwest Territories); the North American* P. petasiti *Spencer is considered a geographical subspecies of* P. tussilaginis *Hendel, described from Europe; and* P. alpina *Groschke, previously known from Scotland and the Alps, is recorded for British Columbia, Yukon and Alaska.*

Douze espèces de Phytomyza *sont connues dans les régions boréales comme mineuses du* Senecio, *du* Petasites *et de la* Tussilago. *Ces espèces appartiennent à trois groupes d'espèces, le groupe* albiceps *(4 espèces), le groupe* syngenesiae *(3 espèces) et le groupe* robustella *(5 espèces). Trois nouvelles espèces sont décrites dans le groupe* robustella, *tel que:* Phytomyza hyperborea *n. sp. (localité-type Walker Fork, Alaska),* P. hypophylla *n. sp. (localité-type Eagle Summit, Alaska) et* P. lugentis *n. sp. (localité-type Summit Lake Pass, Colombie britannique). Dans le groupe* albiceps *une nouvelle sous-espèce est décrite,* Phytomyza tussilaginis kevani *n. ssp. (localité-type Richards Island, Territoires du nord-ouest);* P. petasiti *Spencer d'Amérique du nord est considérée comme sous-espèce géographique de* P. tussilaginis *Hendel, d'Europe; et* P. alpina *Groschke, connue dans le passé d'Écosse et des Alpes, est maintenant notée pour la Colombie britannique, pour le Yukon et pour l'Alaska.*

Zwölf Phytomyza-*Arten werden als Minierer von* Senecio, Petasites *und* Tussilago *in borealischen Gebieten besprochen. Diese gehören zu drei Arten-Gruppen, der* albiceps-*Gruppe (4 Arten), der* syngenesiae-*Gruppe (3 Arten) und der* robustella-*Gruppe (5 Arten). Drei Arten der* robustella-*Gruppe sind neu beschrieben, wie folgt:* Phytomyza hyperborea *n. sp. (Fundort vom Typus Walker Fork, Alaska),* P. hypophylla *n. sp. (Fundort vom Typus Eagle Summit, Alaska) und* P. lugentis *n. sp. (Fundort vom Typus Summit Lake Pass, British Columbia). Bei der* albiceps-*Gruppe wird eine geographische Unterart neue beschrieben,* Phytomyza tussilaginis kevani *n. ssp. (Fundort vom Typus Richards Island, Northwest Territories); die nordamerikanische* P. petasiti *Spencer wird als Unterart von* P. tussilaginis *Hendel (aus Europa beschrieben) vermutet;* P. alpina *Groschke, vorher nur aus Schottland und aus den Alpen bekannt, wird für British Columbia, für Yukon und für Alaska besprochen.*

The present paper deals with the *Phytomyza* miners of part of the Senecioneae. All known *Phytomyza* miners of *Tussilago* and *Petasites* are treated; but I leave out of consideration (as outside my geographical area of interest) the following miners of *Senecio*: *Phytomyza burchardi* Hering (Canary Isles) and *P. seneciovora* Spencer (Africa). K. A. Spencer informs me (in correspondence) that he has recently obtained an undescribed species close to *seneciovora* from a tree *Senecio* in Kenya. He will discuss these species in a later work. In his opinion both belong to the *syngenesiae* group.

The species of *Phytomyza* here treated are referred to three groups, the *albiceps* group, the *syngenesiae* group and the *robustella* group.

The flies from Holland described by de Meijere (1924) as *Phytomyza jacobaeae* were almost certainly not bred from *Senecio*. No one has since succeeded in obtaining from *Senecio* flies which agree with his description. I have seen two female syntypes of this species, and in my opinion they belong to *Phytomyza milii* Kaltenbach, a well-known grass-feeder. The puparia from *Senecio jacobaea* L. associated with these flies by de Meijere doubtless belonged to a species of the *Phytomyza syngenesiae* group; for de Meijere (1926: 267) stated that he could find no morphological difference between these puparia and those of that group (as "*atricornis*"). I suggest that the description of "*jacobaeae*" was the result of an error in associating the wrong flies with these puparia.

The presentation followed in this paper is similar to that of the first paper of this series (Griffiths, 1972), which should be consulted for explanation of the terms and abbreviations used in my descriptions. My use of names of North American plants again follows Hultén (1968). The holotypes of the new species and subspecies described in this paper will be deposited in the Canadian National Collection (Ottawa).

DIAGNOSIS

The species treated in this paper all belong to groups in which identification is based largely on the form of the male genitalia, particularly the aedeagus. The new species whose male is unknown (*Phytomyza hyperborea* n. sp.) may be distinguished from its close relatives by its long antennal pubescence. The difference in the form of the aedeagus between the species of the *albiceps* and *robustella* groups treated here is rather striking, as indicated in my figures. No difficulty should be experienced in identifying males of these species, if a suitable technique of dissection is used. For further information on the more difficult *P. syngenesiae* group, only briefly discussed here, see my earlier revision (Griffiths, 1967).

Keys with worldwide coverage to the mines of *Phytomyza* larvae on *Senecio*, *Petasites* and *Tussilago* are given below. Other genera of Agromyzidae whose larvae are known to attack these host genera are *Liriomyza*, *Calycomyza*, *Ophiomyia* and *Melanagromyza*. Some species of the *albiceps* and *syngenesiae* groups cannot be separated on the basis of their mines and larvae, as indicated in the keys.

The new species of the *robustella* group described in this paper may be included in Spencer's (1969b) key to the *Phytomyza* species of Canada and Alaska by the extensions given below. I am not attempting to revise the couplets to which the species of the *albiceps* group would be referred (couplets 12-16 and 18-25), as I think that this part of the key will need to be substantially rewritten. The distinctions in the range of the costal ratio drawn in Spencer's couplets 12 and 18 are a particular source of difficulty, as the range in some species transgresses the boundaries indicated.

26. Third antennal segment with conspicuously long pubescence 26a
Third antennal pubescence normal 27

26a. Third antennal segment enlarged in female (Spencer 1969b, Fig. 450). Aedeagus as in Spencer's Fig. 451 ..... *lactuca* Frost
– Third antennal segment not enlarged in female (Fig. 31). (♂ unknown) ..... *hyperborea* n. sp.

66. Distal section of aedeagus with large distiphallus containing bifid terminal portion of ejaculatory duct 66a
– Aedeagus not of above type; "supporting sclerites" arising from base of distal section 66b
66a. Orbits distinctly projecting above eye; aedeagus as in Figs. 23-24 ..... *hypophylla* n. sp.
– Orbits not projecting above eye; aedeagus as in Figs. 17-18 ..... *lugentis* n. sp.
66b. (as Spencer's couplet 66)

Key to *Phytomyza* mines on *Senecio*

1. Larva normally leaving leaf before formation of strongly arched brown or black puparium (Fig. 26). Posterior spiracles of puparium and third instar larva with 19-36 bulbs (Fig. 28) ..... (*albiceps* group) 2
– Puparium formed inside leaf, with anterior spiracles turned downwards, projecting through epidermis (Fig. 27). Posterior spiracles of puparium and third instar larva with fewer bulbs 3
2. Canary Isles. Linear mines on *S. papyraceus* DC. ..... *P. burchardi* Hering
– Europe. Mines linear throughout, not more than 1.5 mm wide terminally (Fig. 37), on *S. nemorensis* L., *S. fuchsii* Gmel., *S. subalpinus* Koch and *S. fluviatilis* Wallr. ..... *P. senecionis* Kaltenbach
– Europe. Mines initially linear, but blotchy terminally (Fig. 36). On *S. alpinus* (L.) and *S. jacobaea* L. ..... *P. alpina* Groschke
– North America. Linear mines on *S. lugens* Richards and *S. pauperculus* Michx. (Fig. 35) ..... *P. alpina* Groschke
– Japan. Linear mines on *S. palmatus* Pall. ..... *P. ravasternopleuralis* Sasakawa
3. Puparium bright green; hind spiracles distinctly horned, with about 20 bulbs. Africa. ..... *P. seneciovora* Spencer
– Puparium white, brown or black; hind spiracles knob-shaped, with not more than 12 bulbs 4
4. Mine with narrow linear channel, not more than 2 mm wide (if with blotchy areas, these formed by convolutions of mine channel or by coalescence of mines of different larvae) ..... *P. syngenesiae* group

Three species of this group, *P. syngenesiae* (Hardy), *P. horticola* Goureau and *P. senecionella* Sehgal, are reported from *Senecio*.

– Mine channel broader, often with blotchy areas. North America. On *S. lugens* Richards and *S. sheldonensis* Pors. ..... *P. lugentis* n. sp.

Key to *Phytomyza* mines on *Petasites* and *Tussilago*

1. Larva normally leaving leaf before formation of strongly arched brown or black puparium (Fig. 26). Mines linear, on upper surface of leaf. Posterior spiracles of puparium and third instar larva with 19-31 bulbs (Fig. 28) ..... (*albiceps* group) 2
– Puparium formed inside leaf or petiole, with anterior spiracles turned downwards,

projecting through epidermis (Fig. 27) 3

2. Europe. On *Tussilago* and *Petasites* ..... *P. tussilaginis tussilaginis* Hendel
– Japan. On *Petasites* ..... *P. ravasternopleuralis* Sasakawa
– North America. On *Petasites* ..... *P. tussilaginis petasiti* Spencer
..... or *P. tussilaginis kevani* n. ssp.
..... or *P. alpina* Groschke

3. Larvae feeding mainly in petiole of leaf, in some cases also in veins. Posterior spiracles of puparium and third instar larva with 18-22 bulbs. Europe. On *Petasites* and *Tussilago* ..... *P. buhriella* Spencer
– Larvae feeding on parenchyma of leaf, not in veins or petioles (although the mine channel may run *besides* some of the veins). Posterior spiracles of puparium and third instar larva with fewer bulbs 4

4. Posterior spiracles of puparium and third instar larva with about 15 bulbs. Puparium reddish yellow. North America. On *Petasites* ..... *P. hyperborea* n. sp.
– Posterior spiracles of puparium and third instar larva with 7-12 bulbs (Fig. 29). Puparia mostly white (but some overwintering puparia of *syngenesiae* group brown or black) 5

5. Mines mainly on lower surface of leaf, normally convolute within restricted area (Fig. 34). North America. On *Petasites* ..... *P. hypophylla* n. sp.
– Mines on upper surface of leaf, narrowly linear (about 1 mm wide terminally), 24-28 cm long (Fig. 33A). Europe. On *Tussilago* and *Petasites* .....
..... *P. farfarae* Hendel
– Mines linear, on upper or lower surface, much shorter than those of *farfarae* (less than 10 cm long), in most cases over 1 mm wide terminally .....
..... *P. syngenesiae* group

Two species of this group, *P. horticola* Goureau and *P. senecionella* Sehgal, are reported from *Petasites*.

TREATMENT OF SPECIES

(a) the *Phytomyza albiceps* group

Nowakowski (1962b) has already discussed the possibility of defining a "natural group or subgenus" in this sense. In the *albiceps* group the puparia are strongly arched and dark in colour (brown or black), formed outside the mine (Fig. 26); the aedeagus is characterized by narrow, strongly sclerotized basal sclerites ("arms of basiphallus") and in many species also by the presence of spine-like cuticular processes; and the posterior ors is variable in length (in most individuals shorter than the anterior ors or completely absent). The limits of this group have not yet been clarified, but it is evident that numerous species whose larvae mine Compositae and Umbelliferae belong here. The black-frons species which have been referred to as the "*obscurella* group" should in my opinion also be included in the *albiceps* group.

Identification of many species of the *albiceps* group is only possible through study of the male genitalia. Nowakowski (1962b) has rightly remarked that the reliance on colour differences in Hendel's (1935-6) key has led to artificial separation of closely related species. My present study indicates that gross differences in colour can be shown not only by closely related species, but even by races of the same species. Another character whose high variability has not been appreciated is the length of the posterior orbital bristle (ors). For instance, in *Phytomyza tussilaginis* Hendel the range of variation in the development of this bristle varies from equal length to the anterior ors to complete absence (the extremes can even be shown on either side of the same individual!). Therefore all claims that the

length of the posterior ors can be used for differentiating species of the *albiceps* group should be regarded as doubtful.

K. A. Spencer has in press a note on the type specimens of *Phytomyza albiceps* Meigen. The customary use of this name for a species mining *Artemisia* in Europe has proved to be incorrect. Spencer thinks that the female lectotype probably belongs to the species since described as *Phytomyza rydeniana* Hering. Fortunately the latter species is referable to the *albiceps* group in the wide sense here followed, so there is no need to propose a different group name.

Phytomyza tussilaginis Hendel 1925
(synonymy below under subspecies)

Adult. – Head with orbits not or only very narrowly projecting above eye in lateral view; genae in middle 1/4 to 1/3 of eye height; eyes with only sparse fine pubescence or apparently bare. Frons at level of front ocellus about twice width of eye. Ors directed posteriorly, ori directed inwardly; posterior ors variably developed, in most individuals 1/2 to 2/3 as long as anterior ors, but ranging from fully as long (as in the holotype of subspecies *petasiti*) to completely absent; anterior ori usually 1/2 to 2/3 as long as posterior ori (but in some individuals absent on one side according to Hendel, 1935); orbital setulae one-rowed. Peristomal margin with vibrissa and 4-6 upcurved peristomal setulae. Third antennal article rounded distally, with short pubescence.

3 + 1 dc; acr numerous, in 4-6 rows anteriorly; presutural ia numerous; 7-12 postsutural ia; inner pa 1/3 to 1/2 as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4 2.6-4.0. Wing length 2.2-2.8 mm (see below under subspecies).

Colour geographically variable (see below under subspecies).

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres not clearly delimited from periandrium, bearing only fine setulae. Pregonites extending ventrally, shielding base of aedeagus at rest. Aedeagus as Fig. 6-7; basal sclerites narrow, strongly divergent distally, with row of spinules distally along their dorsal margins; sclerites of medial lobe widely separated anteriorly, convergent and bent upwards posteriorly; distal section with small distiphallus consisting of pair of tubules widely separated from basal section by clear membranous area (without or at most with fine linear traces of pigmentation). Ejaculatory apodeme small (Fig. 8).

A figure of the aedeagus has also been published by Spencer (1969b).

Puparium and third instar larva. – Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with two short horns, with 12-15 bulbs in irregular ellipse. Posterior spiracles borne on short conical processes, with 25-31 bulbs in irregular ellipse. Puparium dark brown or black, 2.0-2.3 mm long (Fig. 26).

Mine. – Larvae leaf-miners on *Tussilago* and *Petasites*. Mine (Fig. 33B) entirely linear, up to 25 cm long, 2-4 mm wide terminally; faeces deposited as discrete particles (separated by over 1 mm in mines on *Tussilago*, but closer together in mines on *Petasites*); mine entirely on upper surface of leaf, appearing white (on *Petasites*) or whitish green (on *Tussilago*) in reflected light; larvae leaving leaf through semicircular slit on upper surface before puparium formation.

A figure has also been given by Beiger (1960) of a mine on *Petasites albus* (L.).

Remarks. – This is the first species of the *albiceps* group in which geographical colour variation has been discovered. Since the colour forms do not differ in morphology or in life-history, I conclude that they are probably geographical races of the same species. Thus I interpret *tussilaginis* as a Rassenkreis or polytypic species. All specimens obtained from forested areas in North America are referable to the yellow subspecies (*petasiti* Spencer), while the new dark subspecies described below was obtained from arctic tundra (see Fig.

38). All European specimens so far described are referable to the nominate subspecies (*tussilaginis* Hendel). However all these specimens are from moderate latitudes, so that the possibility of other races occurring in more northern areas of Europe remains open.

Spencer (1969b) has suggested that the leaf mine of subspecies *petasiti* is shorter and broader than that of subspecies *tussilaginis*. But I can find no such difference in the additional material now available to me. The mine figured by Spencer seems to me untypically short and convolute.

This species has only been bred with certainty from *Tussilago* and *Petasites*. I am doubtful whether Hendel's (1935) record of *Adenostyles* as a host-plant is correct, for that genus does not belong to the Senecioneae. The fly in Hendel's collection bred from *Adenostyles* is a female, whose specific identity will remain uncertain until males can be associated with it.

The type series of *tussilaginis* was bred by Hendel from *Tussilago farfara* L. in Austria. Since only a female from this series has been traced (listed below under subspecies *tussilaginis*), the application of Hendel's name is open to doubt. I here follow the accepted opinion that flies on *Petasites* and *Tussilago* in Europe belong to the same species. But no male has yet been bred from *Tussilago* to confirm this.

Phytomyza tussilaginis tussilaginis Hendel 1925

Phytomyza tussilaginis Hendel. Hendel, 1925:308. –1935:493. Hering, 1927:114. Holotype lost; type-locality, Vienna (Austria).

Adult. – Frons largely clear yellow, but with dark ocellar plate and dark vertex (both vt on dark ground); in some specimens upper part of orbits also slightly infuscated along eye margins. Face partly yellow, but becoming brown in antennal pits and in some specimens also around antennal bases. Genae yellow. Occiput dark. Antennae with first article yellow or yellow-brown, second article brown or black, third article black. Palpi brown or black; labella yellow.

Mesonotum weakly shining, finely grey-dusted, black centrally, brown on sides with traces of brighter coloration (yellow-brown or whitish yellow) around margins of humeral callus and on upper part of sutural triangle. Scutellum black. Pleura black except narrow white band along dorsal margin of mesopleuron and white seam of mesopleural suture. Wing base and squamae contrastingly white, but latter with dark fringe. Legs largely dark, with tips of femora contrastingly yellow; tibiae and tarsi brown.

Abdomen largely brown, becoming yellow-brown on sides at base. Basal cone of ovipositor (♀) grey-dusted on about basal third to half.

Wing length 2.4-2.8 mm. Costal ratio mg_2/mg_4 2.6-4.0.

Material examined. – 1 ♀ paratype from larva 17.x.23 on *Tussilago farfara* L., Vienna University, Austria, emerged 18.iii.24 (in Zoological Museum of Humboldt University, Berlin). 1 ♂, 3 ♀♀ from larvae 29.viii.53 on *Petasites hybridus* (L.), Boxhill, Surrey, England, emerged 16-18.ix.53, leg. G. C. D. Griffiths; 1 ♂, 1 ♀ from larvae 12.ix.54, same plant and locality, emerged 4.x.54 and 29.iii.55, leg. G. C. D. Griffiths. 1 ♂ from larva 21.viii.53 on *Petasites hybridus* (L.), Millers Dale, Derby, England, emerged 10.ix.53, leg. K. A. Spencer.

Other records. – The following records are referred to this subspecies, on the assumption that it is the only member of the *albiceps* group whose larvae mine *Petasites* and *Tussilago* in Europe.

Ireland – Tipperary, 29.viii.69, mines on *Tussilago farfara* L. (K. A. Spencer).

Austria – Volderbad and Haller Strasse (Tirol) on *Tussilago farfara* L. (Hendel, 1925); Mösern (Tirol) on *Tussilago farfara* L. (Griffiths, 1966:807); also sheets in Hering's mine herbarium for Carinthia (Plöckenpass on *Tussilago farfara* L.,

and Mauthen on *Petasites albus* [L.]).

Germany – Neubrandenburg (Mecklenburg) on *Petasites hybridus* (L.) (Buhr, 1941a); Gottesberg, Bad Elster and Oberwiesenthal (Saxony) on *Tussilago farfara* L., *Petasites hybridus* (L.) and *P. albus* (L.) (Buhr, 1964); also sheets in Hering's mine herbarium for Mühlhausen (Thuringia) on *Tussilago farfara* L., Soritz (Bautzen) on *Tussilago farfara* L., Falkenstein (Bavaria) on *Petasites albus* (L.), Tölz (Bavaria) on *Petasites hybridus* (L.), Heimkehle (Alter Stolberg) on *Petasites albus* (L.), and Berlin Botanical Gardens on *Petasites hybridus* (L.).

Italy – Rionero in Vulture, on *Tussilago farfara* L., leg. Ricchello (sheet in Hering's mine herbarium).

Czechoslovakia – Tisová, Orlik and Jesenik (Starý, 1930), mines on *Tussilago farfara* L.

Roumania – Herculesbad (Banat), mines on *Petasites* sp. and *Tussilago farfara* L. (Hering, 1924, nos. 60 and 104); Sinaia, on *Tussilago farfara* L., leg. Sienkiewicz (sheet in Hering's mine herbarium).

Poland – Tatry Mountains, on *Tussilago farfara* L., leg. Nowakowski (Griffiths, 1966: 807); Ojków National Park, on *Petasites albus* (L.) (Beiger, 1960).

Denmark – Hørsholm, on *Petasites hybridus* (L.) (sheet in Hering's mine herbarium).

Finland – mines on *Petasites frigidus* (L.) at Kemi (Ostrobothnia borealis) (Linnaniemi, 1913) and Viborg (Karelia australis) (Frey, 1937).

Russia – Moscow region, mines on *Tussilago farfara* L. (Rohdendorf, 1960).

Hendel (1935) also lists *Petasites paradoxus* (Retz.) as a host-plant, in addition to host species recorded above.

Phytomyza tussilaginis petasiti Spencer 1969, new status

Phytomyza petasiti Spencer. Spencer, 1969b:266. Holotype ♂, Alberta (Canada), in K. A. Spencer's collection.

Adult. – Colour of head as described for subspecies *tussilaginis*, but with dark coloration of vertex less extensive, not enclosing bases of vt in specimens from Alberta and British Columbia (however vte on dark ground in specimens from Yukon and Alaska); face completely yellow, or at most with weak traces of brown in antennal pits.

Mesonotum dark centrally (weakly shining, finely grey-dusted), but with strongly contrasting broad whitish side bands which anteriorly extend inwards along its anterior margin to level of either row of dc, and posteriorly to scutellar suture; outer pa on yellow ground or on boundary between yellow and dark ground; humeral calli with traces of infuscation (a distinct dark spot in some specimens). Scutellum largely dark, but with traces of pale coloration at its basal corners. Pleura extensively whitish, but with dark anteroventral area of variable size on mesopleuron and in some specimens with parts of pteropleuron infuscated; sternopleuron dark ventrally, with pale dorsal band; hypopleuron largely dark. Wing base and squamae white, latter with white or ochreous fringe. Coxae pale apically, dark at base; femora largely dark with contrasting yellow tips; tibiae and tarsi entirely yellow or yellow-brown.

Abdomen extensively yellowish (especially towards sides), in female with contrasting black basal cone of ovipositor (grey-dusted on basal third to half).

Wing length 2.4-2.8 mm. Costal ratio mg_2/mg_4 2.6-4.0.

Material examined. – 1 ♂, 1 ♀ from larvae 4.vii.71 on *Petasites palmatus* (Ait.), Elk Island National Park, Alberta, emerged 27.vii.71 and 28.v.72, leg. G. C. D. Griffiths; 1 ♂, 1 ♀ from larvae 25.vii.71 on *Petasites* (? *palmatus* X *frigidus*), same locality, emerged 13.viii.71 and

15.v.72, leg. G. C. D. Griffiths; 1 ♀ from larva 26.ix.71 on *Petasites sagittatus* (Banks), same locality, emerged 3.vi.72, leg. G. C. D. Griffiths. 1 ♀ from larva 6.viii.70 on *Petasites palmatus* (Ait.), Summit Lake Pass (4200 feet elevation; Alaska Highway mile 392), British Columbia, emerged 19.v.71, leg. G. C. D. Griffiths. 1 ♂, 1 ♀ from larvae 31.viii.69 on *Petasites sagittatus* (Banks), East shore of Lake Teslin, Yukon Territory, emerged 16 & 22.v.70, leg. G. C. D. Griffiths. 1 ♂ from larvae 2-3.viii.68 on *Petasites frigidus* (L.), Walker Fork, Taylor Highway, Alaska, emerged 23.x.68 (forced), leg. G. C. D. Griffiths.

Other records. – The holotype was bred from leaves of *Petasites frigidus* (L.) (= *vitifolius*) collected at Blairmore, Alberta (Spencer, 1969b). Sehgal (1971) records specimens bred from *Petasites sagittatus* (Banks) at Edmonton and Elk Island Park (Alberta).

Phytomyza tussilaginis kevani new subspecies

Adult. – Frons yellow centrally, with ocellar plate and vertex contrastingly shining black (both vt on dark ground); orbits somewhat infuscated, especially along eye margins and around bases of orbital setae. Face clear yellow only on margins, extensively infuscated in antennal pits. Genae yellow. Occiput black, somewhat shining. Antennae with first article brown, second and third articles black. Palpi black; labella yellow.

Thorax weakly shining, finely grey-dusted, almost entirely black, with traces of pale coloration only at margins of humeral calli (especially around anterior spiracles); seams of notopleural and mesopleural sutures white; wing base and squamae contrastingly white, latter with dark fringe. Legs largely dark with tips of femora yellow (but only those of front legs distinctly so in holotype); tibiae and tarsi brown or black. Abdomen entirely dark.

Wing length 2.2-2.3 mm. Costal ratio mg_2/mg_4 2.6-2.7 (lower end of range of values for other subspecies).

Types. – Holotype ♂ from larva 31.vii.70 on *Petasites frigidus* (L.), South shore of Yaya Lake, Richards Island, Northwest Territories (Canada), emerged 6.v.71, leg. P. G. Kevan. 1 ♂ paratype from larva 18.viii.70 on *Petasites frigidus* (L.), Triple Summit (132° 54′ W, 69° 32′ N), Northwest Territories, emerged 4.v.71, leg. P. G. Kevan.

I am pleased to name this subspecies after Dr. Peter G. Kevan, who collected material for me while working in the Arctic.

Phytomyza alpina Groschke 1957

Phytomyza alpina Groschke. Groschke and Hering, 1957:122. Holotype ♂, Bavaria (Germany), in Staatliches Museum für Naturkunde, Ludwigsburg.

Adult. – Head (Fig. 32) with orbits not or only very narrowly projecting above eye in lateral view; genae in middle 1/4 to 1/3 of eye height; eyes with only sparse fine pubescence. Frons at level of front ocellus about twice width of eye. Ors directed posteriorly, ori directed inwardly; posterior ors variably developed, in most specimens about 2/3 as long as anterior ors, but ranging from fully as long to completely absent; anterior ori in most specimens 1/3 to 1/2 as long as posterior ori, but in some absent or represented only by very small setulae; orbital setulae more or less one-rowed. Peristomal margin with vibrissa and 4-7 upcurved peristomal setulae. Third antennal article rounded distally, with short pubescence.

3 + 1 dc; acr in 4-5 rows; 5-10 presutural ia; 4-10 postsutural ia; inner pa over half as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4 2.8-3.4. Wing length 2.2-3.2 mm.

Frons clear yellow centrally, with ocellar plate and vertex contrastingly black (vte on dark ground; vti on boundary between dark and pale ground); orbits largely yellow, but with

traces of infuscation along eye margins and around bases of orbital setae. Face partly yellow, but infuscated in antennal pits. Genae yellow. Occiput black. Antennae with first article yellow-brown, second and third articles black. Palpi black; labella yellow. Thorax largely dark, strongly grey-dusted, scarcely shining; sides of mesonotum with limited area of pale coloration around margins of humeral calli and on upper part of sutural triangle; scutellum dark; mesopleuron with narrow whitish dorsal band along notopleural suture; seam of mesopleural suture whitish; wing base and squamae yellowish white, latter with dark fringe. Legs largely dark, with tips of femora contrastingly yellow. Abdomen largely black or brown. Basal cone of ovipositor (♀) grey-dusted on about basal half.

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres not clearly delimited from periandrium, bearing only fine setulae. Pregonites extending ventrally, shielding base of aedeagus at rest. Aedeagal hood with two pairs of lateral sclerites. Aedeagus as Fig. 1, 2 and 5; basal sclerites narrow, slightly convergent distally; dense group of spinules on left side near dorsal margin of left basal sclerite; on right side less dense group of more dorsally situated spinules nearer centre-line; sclerotization of medial lobe forming loop, confluent anteriorly with basal sclerites; distal section of aedeagus with pair of slender paramesophalli and distiphallus consisting of more or less parallel, paired tubules. Ejaculatory apodeme small (Fig. 3-4).

In most European specimens the tubules of the distiphallus appear rounded dorsally in lateral view (as Fig. 5). But they appear more or less angulate in some British specimens, as in all the specimens from North America (Fig. 1). No clear-cut morphological distinction can be made between populations from the two areas.

Puparium and third instar larva. – Similar to those of *tussilaginis*. In my British series there is an unusually wide range of variation between individuals in the number of spiracular bulbs (anterior spiracles with 14-18 bulbs; posterior spiracles with 22-36 bulbs). The variation is less in North American material (anterior spiracles with 12-15 bulbs; posterior spiracles with 19-25 bulbs) (Fig. 28). Puparium 2.0-2.5 mm long.

Mine. – Larvae leaf-miners on *Senecio* and *Petasites*, leaving leaf through semicircular slit, in most cases on upper surface, before puparium formation. Mines on upper surface of leaf, appearing white or greenish white in reflected light, geographically variable in shape (Fig. 35-36).

In Europe mines have been reported only on *Senecio alpinus* (L.) and *S. jacobaea* L. Mine (Fig. 36) initially linear but becoming progressively broader and more or less blotchy terminally; faeces deposited as discrete particles, well separated (mostly by over 1 mm) in terminal part of mine.

In North America I have bred this species from mines on *Petasites*, as well as on *Senecio* (see records below). Mine (Fig. 35) retaining its linear appearance throughout, up to 15 cm long, 2-3 mm wide terminally; faecal particles separated by about 2 mm in terminal part of mines on *Senecio lugens* Richards, but more numerous and separated by less than 1 mm in mines on *Petasites*.

Material examined. – 1 ♂ paratype from larvae on *Senecio alpinus* (L.), Partnachklamm, Bavaria, Germany, emerged 27.viii.51, leg. F. Groschke. 5 ♂♂, 7 ♀♀ from larvae 30.vii.62 on *Senecio jacobaea* L., Ingleborough, Yorks., England, emerged 26-31.viii.62, leg. G. C. D. Griffiths. 8 ♂♂, 5 ♀♀ from larvae 6.ix.64 on *Senecio jacobaea* L., Gorsdale Scar, Yorks., England, emerged 5-12.x.64 and 22.iv.65 (1 ♂), leg. G. C. D. Griffiths. 6 ♂♂, 1 ♀ from larvae 10.vi.65 on *Senecio jacobaea* L., Mullagh More, Clare, Ireland, emerged 2-8.vii.65, leg. G. C. D. Griffiths. 2 ♂♂ from larvae 31.viii.66 on *Senecio jacobaea* L., Derreen, Clare, Ireland, emerged 6-27.iii.67, leg. G. C. D. Griffiths.

1 ♂, 2 ♀♀ from larvae 31.viii.69 on *Petasites sagittatus* (Banks), on East shore of Lake

Teslin, Yukon Territory, emerged 17-26.v.70, leg. G. C. D. Griffiths. 1 ♂, 1 ♀ from larvae 30.viii.69 on *Senecio pauperculus* Michx., Lake Laberge, Yukon Territory, emerged 17-19.v. 70, leg. G. C. D. Griffiths. 1 ♀ from larvae 19-26.vii.68 on *Petasites frigidus* (L.), Eagle Summit (3900 feet elevation), Steese Highway, Alaska, emerged 8.x.68 (forced), leg. G. C. D. Griffiths. 3 ♂♂, 2 ♀♀ from larvae 3-11.viii.70 on *Senecio lugens* Richards, Summit Lake Pass (4200 feet elevation; Alaska Highway mile 392), British Columbia, emerged 12-13.v.71, leg. G. C. D. Griffiths; 1 ♀ from larva 9.ix.71, same plant and locality, emerged 11.v.72, leg. G. C. D. Griffiths.

Other records. – Groschke's original material was bred from *Senecio alpinus* (L.) in the Bavarian Alps (Partnachklamm and Lenggries). Other localities where mines on *Senecio alpinus* (L.) have been recorded are Tölz (Bavaria), Kleiner Walsertal and Eisenerzer Reichenstein (Austria) (*in* Groschke and Hering, 1957), and Maloja, Switzerland (*in* Griffiths, 1966). The first British record was from Kinlochewe, Ross (Scotland), mines on *Senecio jacobaea* L. collected by O. W. Richards on 10.vii.53 (Spencer, 1956). Other Irish localities (all in the Burren area of County Clare) are given by Griffiths (1968).

Remarks. – The known distribution of this species is indicated on Fig. 39.

I am not able to distinguish the leaf mines of this species on *Petasites* in North America from those of *tussilaginis*. Although the *maximum* length of mines of *tussilaginis* in the available samples is longer, there is overlap between the species in respect of this measurement.

The species described by Nowakowski (1962b) as *Phytomyza aronici* is the sister-species of *alpina*. The aedeagus of *aronici* is very similar to that of *alpina*, particularly in respect of the asymmetrical development of the groups of spinules (an undoubtedly apomorphous character). The only clear differences which I have noted involve the shape of the paramesophalli and the situation of the left group of spinules closer to the left basal sclerite in *aronici*. The type series of *aronici* was bred from mines on *Doronicum clusii* (All.), a member of the Senecioneae, in the Tatry Mountains of Poland (1600-2400 metres elevation).

Phytomyza senecionis Kaltenbach 1869

Phytomyza senecionis Kaltenbach. Kaltenbach, 1869:176. –1874:364. Hendel, 1935:478.

Types lost; type-locality, Germany.

Adult. – Head with orbits not or only narrowly projecting above eye in lateral view; genae in middle about 1/4 of eye height; eyes with only sparse fine pubescence. Frons at level of front ocellus about twice width of eye. Ors directed posteriorly, ori directed inwardly; posterior ors variably developed, ranging from two-thirds as long as anterior ors to completely absent; anterior ori short, not more than half as long as posterior ori; orbital setulae irregularly one-rowed. Peristomal margin with vibrissa and 4-5 upcurved peristomal setulae. Third antennal article rounded distally, with short pubescence.

3 + 1 dc; acr in 4-5 rows; 7-10 presutural ia; 8-11 postsutural ia; inner pa about half as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4 3.3-4.1. Wing length 2.1-2.6 mm.

Frons clear yellow except dark ocellar plate (both vt on yellow ground). Face largely or completely yellow, at most infuscated in antennal pits. Genae yellow. Occiput dark. Antennae with first article yellow-brown, second and third articles brown to black. Palpi brown or black; labella yellow. Mesonotum dark centrally (weakly shining, finely grey-dusted), but with strongly contrasting broad whitish side bands which enclose the humeral calli (indicated by small dark spot) and extend posteriorly to the scutellar suture; outer pa on boundary between yellow and dark ground; scutellum dark; mesopleuron whitish on upper third to half, dark ventrally; other pleura largely dark, but with some pale coloration along

sutures. Wing base and squamae white, latter with contrastingly dark fringe. Coxae dark; femora largely dark with contrasting yellow tips; tibiae and tarsi deep yellow or yellow-brown. Abdomen largely brown, but yellow on sides at base. Basal cone of ovipositor (♀) grey-dusted on basal half to two-thirds.

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres not clearly delimited from periandrium, bearing only fine setulae. Ventral extensions of pregonites inconspicuous, more or less membranous. Aedeagal hood with two pairs of lateral sclerites. Aedeagus as Fig. 11; basal sclerites with angular notches (notch on left sclerite lower than that on right) near each of which lies a group of spinules; sclerotization of medial lobe forming loop; distal section small, with conspicuous spine on left side, with poorly differentiated distiphallus (pigmented only around its margins). Ejaculatory apodeme rather large (Fig. 12).

Puparium and third instar larva. – Similar to those of *tussilaginis*. Anterior spiracles with 9-11 bulbs; posterior spiracles with 21-28 bulbs. Puparium 1.7-2.1 mm long.

Mine. – Larvae leaf-miners on *Senecio*. Mine (Fig. 37) entirely linear, up to 23 cm long, in many cases following midrib for long distance, remaining narrow terminally (not more than 1.5 mm wide); faeces deposited as fine particles, in some cases forming short strips; most mines confined to upper surface of leaf (but some beginning on lower side according to Hering, 1957b), appearing contrastingly white in reflected light; larvae leaving leaf through semicircular slit on upper surface before puparium formation.

A figure of the mine has also been given by Hering (1957b).

Material examined. – 1 ♂ from larva 10.vi.54 on *Senecio fuchsii* Gmel., Kunnersdorf (near Görlitz), Germany, emerged 28.vi.54, leg. E. M. Hering (no. 6040). 2 ♀♀ from larvae 23.viii.63 on *Senecio nemorensis* L., North of Como, Italy, emerged 17-22.ix.63, leg. G. C. D. Griffiths.

Other records. – According to Hering (1957b) the larvae of this species occur commonly on *Senecio nemorensis* L. and *S. fuchsii* Gmel. in Central Europe. Records are as follows.

Holland – Berg en Dal and Valkenburg on *Senecio fuchsii* Gmel. (de Meijere, 1926, as "*Phytomyza lappae* Gour.").

Germany – Kaltenbach's original material was bred from *Senecio nemorensis* L. (locality not stated). Buhr (1964) lists localities in Saxony, where he reports this species as common on *Senecio fuchsii* Gmel. Voigt (1929) records mines at Geisenheim and Laacher See (Rheingau); Zoerner (1969) at Saarensee (Middle Elbe region). There are also sheets of *Senecio fuchsii* Gmel. in Hering's mine herbarium for Frankenhausen (Thuringia), Alter Stolberg (Südharz), Siegen (Westphalia), Schlosspark/Torga (Lausitz), Lowenburg/Rhöndorf (Rheinland) and the Mosel Valley (Rheinland).

Austria – Sheets of *Senecio fuchsii* Gmel. in Hering's mine herbarium for Linz (Donau) and Tal der Grossen Mühlviertel.

Czechoslovakia – Starý (1930) lists localities where larvae were collected on *Senecio fuchsii* Gmel. He also reports this species on *Senecio jacobaea* L. at Tisová, which record needs checking as this plant is a host of *Phytomyza alpina* Groschke (not yet described when Starý wrote).

Bulgaria – Rila Mountains, on *Senecio nemorensis* L. (Buhr, 1941b).

Poland – Collected by Nunberg (1948) and Nowakowski (1962a:152) on *Senecio nemorensis* L., *S. fuchsii* Gmel. and *S. subalpinus* Koch at various localities in the Tatry Mountains (see also Griffiths, 1966:797, 807, and 809); also found by Nowakowski on *Senecio fluviatilis* Wallr., near Sztum and Warsaw (Nowakowski, 1962a:152); Beiger (1959, 1965) gives records for the district of Wieliczka (on *Senecio fuchsii* Gmel.) and for the Kraków-Wieluń Jura (on *Senecio nemorensis* L.).

Denmark – Maribo (Sønderup, 1949).

Whether this species occurs in Scandinavia has not been established. Rydén's (1952) record for Sweden is doubtful, since it is based on a caught female.

Phytomyza ravasternopleuralis Sasakawa 1955, new status

Phytomyza senecionis ravasternopleuralis Sasakawa. Sasakawa, 1955:19. – 1961a:468. Holotype ♂, Aomori prefecture (Japan), in Entomological Laboratory, Saikyo University.

Adult. – As described for *senecionis*, except as follows.

Sternopleuron entirely dark, without pale dorsal band along suture.

Distal section of aedeagus (Fig. 9) longer, with weakly differentiated paramesophalli and slender distiphallus whose tubules are almost parallel apically. Ejaculatory apodeme small (Fig. 10).

For further description and figures see Sasakawa (1955, 1961a).

Puparium and third instar larva. – Similar to those of *tussilaginis* and *senecionis*. Anterior spiracles with 11-14 bulbs; posterior spiracles with 22-28 bulbs. Puparium about 2 mm long. For further description and figures see Sasakawa (1961a).

Mine. – Larvae leaf-miners on *Senecio* and *Petasites*. Sasakawa (1955) describes the mines as linear throughout ("ophionome"), whitish, yellowish or yellowish green in colour, 7-13.5 cm long, on upper surface of leaf; faeces deposited in short strips or as fine particles; larvae leaving leaf through semicircular slit on upper surface before puparium formation. Figures of the mine are given by Sasakawa (1955, 1961a).

Material examined. – 1 ♂ from larvae on *Petasites japonicus* Miq., Mominoki, Mount Sara, Ehime prefecture (Shikoku), Japan, leg. T. Yano (May 1954).

Other records. – The type series was bred from *Senecio palmatus* Pall. at Towada Park, Aomori prefecture, Japan (Sasakawa, 1955).

Remarks. – I propose to consider *ravasternopleuralis* a full species, rather than a subspecies of *senecionis* (as it was described by Sasakawa), because the form of the distiphallus is substantially different from that of the only male of *senecionis* available to me. But this judgement is only tentative, in view of the limited material available.

Sasakawa (1961a) referred specimens bred from *Petasites japonicus* Miq. to "*Phytomyza lappae* Robineau-Desvoidy". However the aedeagus of the male from this plant lent me by Sasakawa (Fig. 9) does not agree with his figure of "*lappae*", but rather with his figure of *ravasternopleuralis*. I conclude that the Japanese flies from *Petasites* should be referred to the latter taxon.

(b) the *Phytomyza syngenesiae* group

I have discussed the definition of the *Phytomyza syngenesiae* group and given descriptions of species in my 1967 revision. One additional species (*senecionella*) has since been described by Sehgal (1971). In this group the puparia remain inside the leaf, as in the *robustella* group. But the form of the aedeagus is very different, characterized (*inter alia*) by inclusion of the terminal part of the ejaculatory duct in an unpaired distal tubule.

The two polyphagous species of this group, *Phytomyza syngenesiae* (Hardy) and *P. horticola* Goureau, probably occur commonly on *Senecio* (see records below). Whether they also sometimes attack *Tussilago* and *Petasites* requires confirmation. Records of "*Phytomyza atricornis* Meigen" (a name formerly used for species of this group) on *Petasites* and *Tussilago* in Europe were published, for instance, by Hering (1924, 1927), de Meijere (1926) and Starý (1930). But these records antedate the description of *P. farfarae* Hendel,

and confusion with that species must therefore be suspected. In 1967 I dissected three males identified as "*atricornis*" in Hering's collection and they all proved to belong to *farfarae*. The only European record since the description of *farfarae* is Sønderup's (1949) report of "*atricornis*" on both *Tussilago* and *Petasites* in Denmark. This record cannot be checked, as no adult flies are known to have been obtained from his samples.

Phytomyza syngenesiae (Hardy)

I have given firm records for *Senecio jacobaea* L., *S. cruentus* DC. and *S. squalidus* L. in Europe (Griffiths, 1967). There are many other published records of "*Phytomyza atricornis* Meigen" on species of *Senecio* in Europe, but I cannot determine whether they refer to *syngenesiae* or *horticola*. In North America *Senecio cruentus* DC., *S. mikanioides* Otto and *Petasites* sp. are recorded as hosts (Frick, 1959; Griffiths, 1967). The last record requires confirmation in view of possible confusion with species of the *robustella* group.

My previous opinion (Griffiths, 1967) that this species dispersed across the Bering land bridge between Siberia and Alaska is now withdrawn. The most northern locality for *syngenesiae* in North America is the City of Edmonton (Alberta), where it has been collected only once and does not seem established. The species does not occur in the boreal forest nor in coastal regions of Alaska, where trans-Beringian migrants are expected to occur. The only species of the *syngenesiae* group so far found in such northern areas is *senecionella*. I now think it more likely that *syngenesiae* was introduced into North America with horticultural plants.

Phytomyza horticola Goureau

I have given firm records for *Senecio vulgaris* L., *S. vernalis* W. et K. and *S. doria* L. in Europe (Griffiths, 1967). For Japan Sasakawa (1961b) lists *Senecio vulgaris* L., *S. cruentus* DC. and *Petasites japonicus* Miq. as host plants.

Phytomyza senecionella Sehgal

Sehgal (1971) has described this species on the basis of material bred from *Senecio congestus* (R. Br.) var. *palustris* (L.) at Elk Island National Park (shores of Tawayik Lake), Alberta. His figure 123 indicates that the distal tubule of the aedeagus has a characteristic sinuate shape, by which the species may be distinguished from *syngenesiae*. I have figured (Fig. 13) the aedeagus of a male bred from *Petasites frigidus* (L.) at Eagle Summit (3900 feet elevation), Steese Highway, Alaska (emerged 26.vii.68 from puparium collected 19.vii. 68, leg. G. C. D. Griffiths). Probably *Petasites* is only an occasional host of this species, for only a single mine was found. The main host at Eagle Summit was *Senecio atropurpureus* (Ledeb.) subsp. *tomentosus* (Kjellm.) (1 ♂, 2 ♀♀ emerged 24-26.vii.68 from puparia collected 17.vii.68). Mines were also found the same day on *Senecio yukonensis* Pors. While the male genitalia of these Alaskan specimens agree substantially with Sehgal's figure, the coloration of the head is darker than in the original series, with the frons largely orange-brown with grey-dusted orbits.

Leaf mines collected at Eagle Summit are 6-7 cm long, 1.5-2.0 mm wide terminally; faecal particles discrete, mostly separated by 0.75-1.00 mm in terminal part of mine; mines formed mainly on upper surface of leaf, with puparium formation following in most cases on lower surface.

(c) the *Phytomyza robustella* group

The term "*Phytomyza robustella* group" has been used to include certain species whose larvae produce gall-like swellings in the midrib of the leaves of Compositae. However no clear morphological distinction can be drawn between these species and certain other species whose larvae are leaf- or stem-miners on Compositae, not forming swellings. Spencer (1971) has already referred to this group one such species, *P. buhriella* Spencer (as *notabilis*). In the present work I treat that species and some additional leaf-mining species whose male genitalia are of similar type. The puparia of all species referred to this group remain in the plant tissue, with the anterior spiracles turned downwards so that they project ventrally through the epidermis. A similar apomorphous type of puparium is shown by the *Phytomyza syngenesiae* group and related groups, as discussed in the first paper of this series (Griffiths, 1972). Species of the *Phytomyza robustella* group differ from those groups most obviously in respect of the structure of the aedeagus, retaining a forked distiphallus (containing the bifid terminal portion of the ejaculatory duct) and lacking "supporting sclerites". However since these aedeagal characters are probably plesiomorphous for *Phytomyza*, they do not provide a satisfactory indication of the limits of the group. My delimitation of the "*Phytomyza robustella* group" is therefore only tentative.

Phytomyza buhriella Spencer 1969

Phytomyza spec. Hering, 1957a:93. –1957b:746 (no. 3604a).

Phytomyza buhriella Spencer. Spencer, 1969a:21. Holotype ♂, Mühlhausen (Germany), in K. A. Spencer's collection.

Phytomyza notabilis Spencer. Spencer, 1971:182. Holotype ♂, Edinburgh (Scotland), in University Museum, Oxford. New synonymy.

The synonymy of *notabilis* has been pointed out in correspondence by M. von Tschirnhaus.

Adult. – External form and colour as described by Spencer (1969a).

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres not clearly delimited from periandrium (without suture on outer side), bearing numerous fine setulae. Pregonites not extending ventrally. Aedeagal hood with one pair of lateral sclerites. Aedeagus as in Fig. 15; basal sclerites rather broad, more or less parallel distally; medial lobe large, with distinct sclerites; distal section with broad paramesophalli whose sclerotization is confluent with V-shaped distiphallus. Ejaculatory apodeme as Fig. 16.

Puparium and third instar larva. – See the detailed larval description given by Hering (1957a:93) (as *Phytomyza* spec.). The larvae can be distinguished from those of all other species treated in this paper by the presence of a pair of sclerotized processes of the mandibular adductor apodeme on either side of the labial sclerite (as also in gall-forming species of the *robustella* group), and the large size and annulate appearance of the frontal process. Spiracles (both anterior and posterior) with 18-22 bulbs. Puparia white.

Mine. – Larvae miners on *Petasites* and *Tussilago*. Mines linear, formed mainly in petioles of basal leaves (but in some cases beginning in leaf vein); faecal particles inconspicuous (Hering, 1957b:746). Puparium with its ventral surface adjacent to surface of petiole, with its anterior spiracles projecting ventrally through epidermis.

Material examined. – 5 ♂♂ swept on *Tussilago farfara* L., 28.v.67, Ihlkate, SW Kiel, Germany, leg. M. von Tschirnhaus.

Other records. – The type series of *buhriella* was bred by H. Buhr from *Petasites albus* (L.) at Mühlhausen, Thuringia, Germany. Buhr (1964) has also reported mines from

Oberwiesenthal (Erzgebirge). Von Tschirnhaus has obtained further material (both swept and bred) from *Tussilago farfara* L. in Schleswig-Holstein. In Britain this species is known from a male taken at Edinburgh, Scotland, 2.vi.1905 (holotype of *notabilis*); and I found puparia in petioles of *Tussilago farfara* L. at Leeds, Yorks., in October 1964.

Phytomyza farfarae Hendel 1935

Phytomyza farfarae Hendel. Hendel, 1935:400. De Meijere, 1938:90. Holotype ♀, without locality label (presumably Austria), in the Naturhistorisches Museum, Vienna.

Adult. – Head with orbits only very narrowly projecting above eye in lateral view; genae in middle about 1/3 of eye height; eyes with sparse fine pubescence or virtually bare. Frons at level of front ocellus about twice width of eye. Two ors, of equal length, posteriorly directed; only one strong ori, inwardly directed (anterior ori absent or represented by short setula); orbital setulae one-rowed. Peristomal margin with vibrissa and 3-4 upcurved peristomal setulae. Third antennal article rounded distally, with short pubescence.

3 + 1 dc; acr few, in two rows; ia few (4-5 presutural; 1-3 postsutural); inner pa 1/3 to 1/2 as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4 2.1-2.7. Wing length 2.1-2.7 mm.

Frons deep yellow or brown centrally, with ocellar plate and vertex contrastingly dark (both vt on dark ground, or vti on boundary between dark and pale ground); orbits grey along eye margins. Face largely dark brown, in some specimens becoming yellow towards sides. Genae deep yellow or brown. Occiput black. Antennae with first article yellow-brown or brown, second and third articles dark brown or black. Palpi black; labella yellow. Thorax dark, strongly grey-dusted, scarcely shining, with pale coloration only along notopleural and mesopleural sutures; wing base yellow or ochreous; squamae with dark margin and fringe. Legs largely dark, with tips of femora contrastingly yellow. Abdomen largely brown. Basal cone of ovipositor (♀) grey-dusted on about basal two-thirds.

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres delimited from periandrium by distinct suture on outer side, bearing numerous fine setulae. Pregonites not extending ventrally. Aedeagal hood with one pair of lateral sclerites. Aedeagus as in Fig. 20-21; basal sclerites rather broad, divergent distally; medial lobe without or with only weak traces of sclerotization; distal section with pair of small paramesophalli and large Y-shaped distiphallus. Ejaculatory apodeme as Fig. 22.

Puparium and third instar larva. – Mandibles with two alternating teeth; right mandible longer than left. Spiracles as described and figured by de Meijere (1938:90); anterior spiracles knob-shaped, with about 9 bulbs; posterior spiracles also knob-shaped, about same size as anterior spiracles, with 7-11 bulbs. Puparium white, 2.2-2.7 mm long.

Mine. – Larvae leaf-miners on *Tussilago* and *Petasites*. Mine (Fig. 33A) interparenchymal, pale green in reflected light, entirely linear, 24-28 cm long, about 1 mm wide terminally, in many cases with long straight stretches besides some of main veins; faeces deposited in very fine particles, often forming long beaded strips (in Perlschnüren zusammenhängend) on one side of mine; main part of mine formed on upper surface of leaf, but with puparium formed at end of short channel on lower surface. Puparium with its ventral surface adjacent to surface of leaf, with its anterior spiracles projecting ventrally through epidermis.

Material examined. – 3 ♂♂, 4 ♀♀ from puparia 19.viii.64 on *Tussilago farfara* L., Mösern (1250 metres elevation), Tirol, Austria, emerged 28.viii-7.ix.64, leg. G. C. D. Griffiths. 1 ♂ from puparium 4.ix.55 on *Petasites* sp., Garmisch, Bavaria, Germany, emerged 21.ix.55, leg. K. A. Spencer.

Other records. – This species can be definitely accepted as occurring only in central Europe and the Balkans. Additional firm records are as follows.

Austria – found "everywhere" according to Hendel (1935); Stanzach im Lechtal, on *Tussilago farfara* L. (de Meijere, 1938); also sheets in Hering's mine herbarium for Mauthen (Carinthia) on *Petasites albus* (L.), Tal der Grossen Mühlviertel on *Petasites paradoxus* (Retz.), Heiligenblüt (Tauern) on *Tussilago farfara* L., and Warscheneck-Gebirge (Linzershaus, 1400 metres elevation) on *Tussilago farfara* L.

Germany – Mühlhausen, Thuringia, on *Petasites albus* (L.) (Buhr, 1960); Lenggries, Bavaria, on *Tussilago farfara* L., leg. Groschke (Griffiths, 1966).

Poland – common in the Tatry Mountains (Nowakowski, in correspondence).

Roumania – Sinaia, ix.57 (sheet in Hering's mine herbarium).

Bulgaria – Rila Mountains, on *Tussilago farfara* L. and *Petasites albus* (L.) (Buhr, 1941b).

Records for Denmark (Rydén, Lyneborg and Nielsen, 1963) and Ångermanland, Sweden (Rydén, 1956) cannot be accepted, as they are based on caught specimens which have not been dissected. Rydén's (1947) record for Jämtland, Sweden, is almost certainly erroneous, since the fly was bred from *Solidago*. Hendel (1935) also referred to this species a series of caught specimens from Jakutsk (Siberia) in the Leningrad Museum. They were misidentified; on dissection I found that they belong to the grass-feeding *Phytomyza fuscula* Zetterstedt, in the sense clarified by Spencer (1969b).

Phytomyza hyperborea new species (♀)

Adult. – As described for *farfarae*, except as follows.

Third antennal article with long upcurved pubescence distally (Fig. 31).

Costal ratio mg_2/mg_4 2.6. Wing length 2.4 mm.

Frons largely deep yellow, slightly grey-dusted along eye-margins, with ocellar plate contrastingly dark; dark coloration of vertex less extensive (vti on yellow ground, vte on boundary between dark and yellow ground). Face deep yellow, only slightly infuscated in antennal pits. Genae deep yellow. Wing base contrastingly yellow; squamae pale with ochreous fringe. Abdomen largely brown, but yellow on sides at base and with yellow bands on hind margins of all terga.

Puparium and third instar larva. – Mandibles with two alternating teeth; right mandible longer than left. Spiracles knob-shaped, anterior with about 20 bulbs, posterior with 15 bulbs. Puparium reddish yellow, 2.6 mm long.

Mine. – The single specimen was bred from a puparium found at the end of a linear mine with widely spaced faecal particles on the upper surface of a leaf of *Petasites frigidus* (L.). Since much of the mine had been destroyed through the feeding of a large tephritid larva in the same leaf, a full description is not possible. Puparium with its ventral surface adjacent to upper surface of leaf, with its anterior spiracles projecting ventrally through epidermis.

Type. – Holotype ♀ from puparium 2.viii.68 on *Petasites frigidus* (L.), Walker Fork, Taylor Highway, Alaska, emerged 21.x.68, leg. G. C. D. Griffiths.

Remarks. – Long pubescence on the third antennal article is also shown by *Phytomyza ciliata* Hendel, a European species of the *robustella* group whose larvae mine the leaves of *Chrysanthemum leucanthemum* L. *Phytomyza hyperborea* differs from that species as follows: (1) orbits not projecting above eye in lateral view; (2) higher costal ratio mg_2/mg_4 (less than 2.0 in *ciliata*); and (3) more extensive yellow coloration (vti on yellow ground, face largely yellow, abdomen yellow on sides at base and with yellow bands on hind margins of all terga).

Under natural conditions the holotype would not have emerged until the following spring. The late autumn emergence was due to delay in my obtaining outdoor storage facilities.

Phytomyza hypophylla new species

Adult. – As described for *farfarae*, except as follows.

Head (Fig. 30) with orbits more distinctly projecting above eye in lateral view; genae in middle 1/2 to 2/5 of eye height. Third antennal article with slightly longer pubescence than in *farfarae* (but not so long as in *hyperborea*).

Costal ratio mg_2/mg_4 1.7-2.1 (lower than in both *farfarae* and *hyperborea*). Wing length 2.1-2.7 mm.

Head darker coloured; orbits entirely dark, densely grey-dusted; centre of frons grey-dusted over brown to reddish black ground colour; face largely dark brown or black; genae brown.

Male postabdomen and genitalia very similar to those of *farfarae*, but with some difference in shape of distiphallus (Fig. 23-24). Ejaculatory apodeme larger (Fig. 25).

Puparium and third instar larva. – As in *farfarae*. Spiracles knob-shaped, anterior with 8-10 bulbs, posterior (Fig. 29) with 7-11 bulbs. Puparium white, 2.1-2.7 mm long (Fig. 27).

Mine. – Larvae leaf-miners on *Petasites*. Mine (Fig. 34) formed mainly on lower surface of leaf, basically linear but usually convolute within restricted area, forming irregular secondary blotch, very inconspicuous (virtually concealed in reflected light by dense pile of leaf); on upper surface of leaf at most short stretches of mine channel or area of brownish discoloration visible; faeces deposited as very fine particles, in some cases forming short strips. Puparium with its ventral surface adjacent to lower surface of leaf, with its anterior spiracles projecting ventrally through epidermis.

Types. – Holotype ♂; 2 ♂♂, 7 ♀♀ paratypes from larvae and puparia 19-26.vii.68 on *Petasites frigidus* (L.), Eagle Summit (3900 feet elevation), Steese Highway, Alaska, emerged 26.vii-12.viii.68, leg. G. C. D. Griffiths. 3 ♂♂ paratypes from puparia 16-25.viii.71 on *Petasites hyperboreus* Rydb., near Mount Cavell Chalet (5800-7400 feet elevation), Jasper National Park, Alberta, emerged 23.viii-3.ix.71, leg. G. C. D. Griffiths.

Remarks. – I have also bred a female from undersurface mines collected at Walker Fork, Alaska (from larvae and puparia 2-3.viii.68 on *Petasites frigidus* (L.), emerged 20.viii.68, leg. G. C. D. Griffiths). In this specimen the colour of the head is as in *farfarae*, with the frons largely yellow-brown. In the absence of associated males I cannot judge whether this specimen represents an additional undescribed species of the *robustella* group, or a colour variant of *hypophylla*.

Phytomyza lugentis new species

Adult. – As described for *farfarae*, except as follows.

Costal ratio mg_2/mg_4 1.9-2.2. Wing length 2.5-2.8 mm.

Head darker coloured (compare also *hypophylla*); centre of frons brown or ochreous; face largely black; genae brown; antennae entirely black; labella yellow-brown or red-brown. Abdomen black. Basal cone of ovipositor (♀) grey-dusted on about basal third to half.

Male postabdomen and genitalia similar to those of *farfarae* in most respects, but with clear differences in form of aedeagus (Fig. 17-18). Distal section of aedeagus with larger Y-shaped distiphallus, without paramesophalli; medial lobe with loop of unpigmented sclerotization. Ejaculatory apodeme larger (Fig. 19).

Puparium and third instar larva. – As in *farfarae*. Spiracles knob-shaped, anterior with 9-10 bulbs, posterior with 7-10 bulbs. Puparium white, 2.3-2.6 mm long.

Mine. – Larvae leaf-miners on *Senecio lugens* Richards and *S. sheldonensis* Pors. Mine formed on upper or lower surface of leaf (largely on lower surface in most cases), variable in shape (more or less linear throughout, or partly linear with irregular blotchy areas); faeces deposited as discrete particles (separated by over 1 mm in terminal part of mine). Puparium with its ventral surface adjacent to lower surface of leaf, with its anterior spiracles projecting ventrally through epidermis.

Types. – Holotype ♂; 2 ♂♂, 4 ♀♀ paratypes from puparia 3-11.viii.70 on *Senecio lugens* Richards, Summit Lake Pass (4200 feet elevation; Alaska Highway mile 392), British Columbia, emerged 7-15.viii.70, leg. G. C. D. Griffiths. 2 ♂♂ paratypes from puparia 5.viii.70 on *Senecio sheldonensis* Pors., same locality (5000 feet elevation), emerged 12.viii.70, leg. G. C. D. Griffiths.

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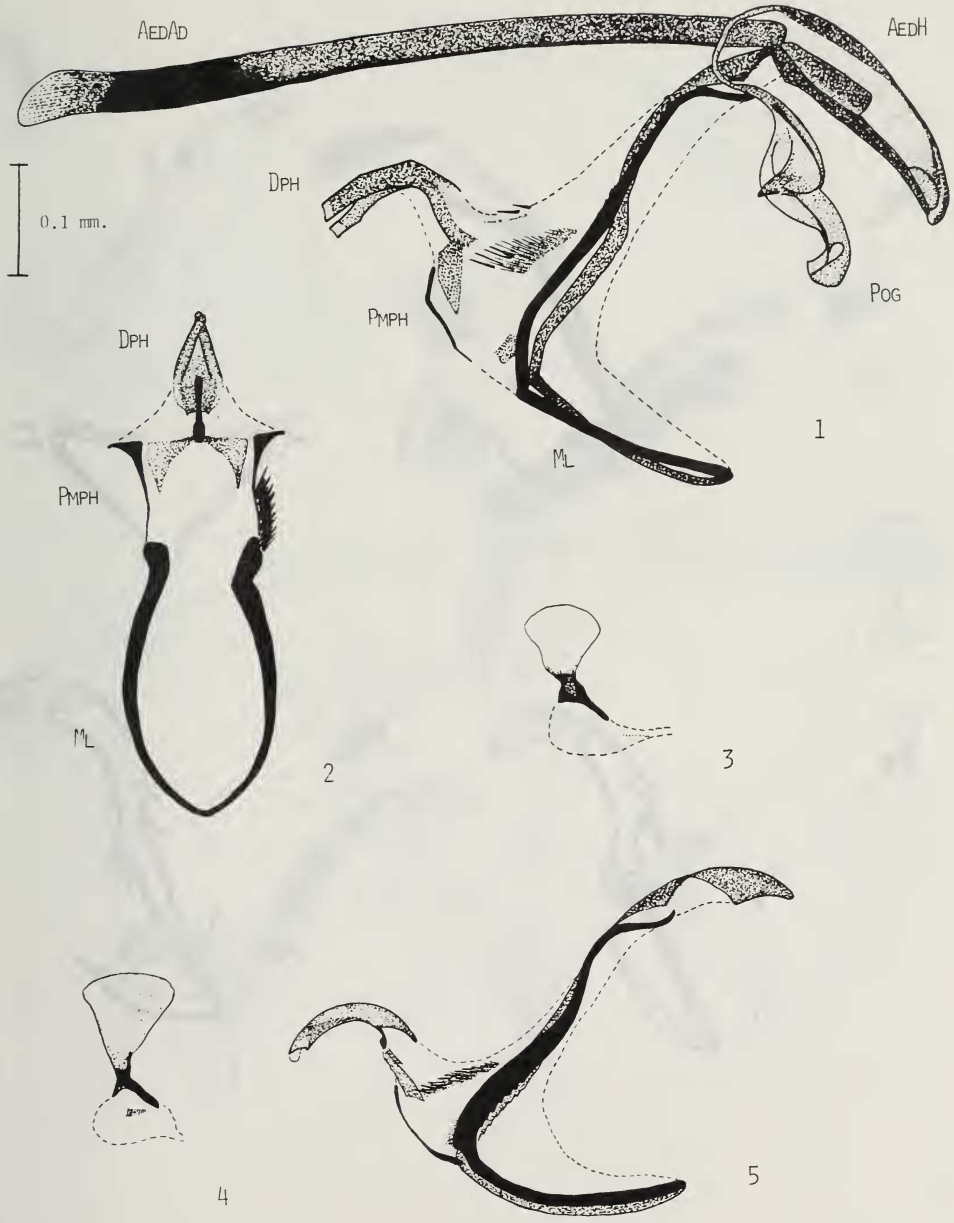

Fig. 1-3. *Phytomyza alpina* Groschke (♂), Lake Teslin, Yukon: 1, aedeagus and associated structures in lateral view (AEDAD aedeagal apodeme, AEDH aedeagal hood, DPH distiphallus, ML medial lobe, PMPH paramesophallus, POG postgonite); 2, distal section and medial lobe of aedeagus in anteroventral view (lettering as Fig. 1); 3, ejaculatory apodeme. Fig. 4-5. *Phytomyza alpina* Groschke (♂), England: 4, ejaculatory apodeme; 5, aedeagus in lateral view.

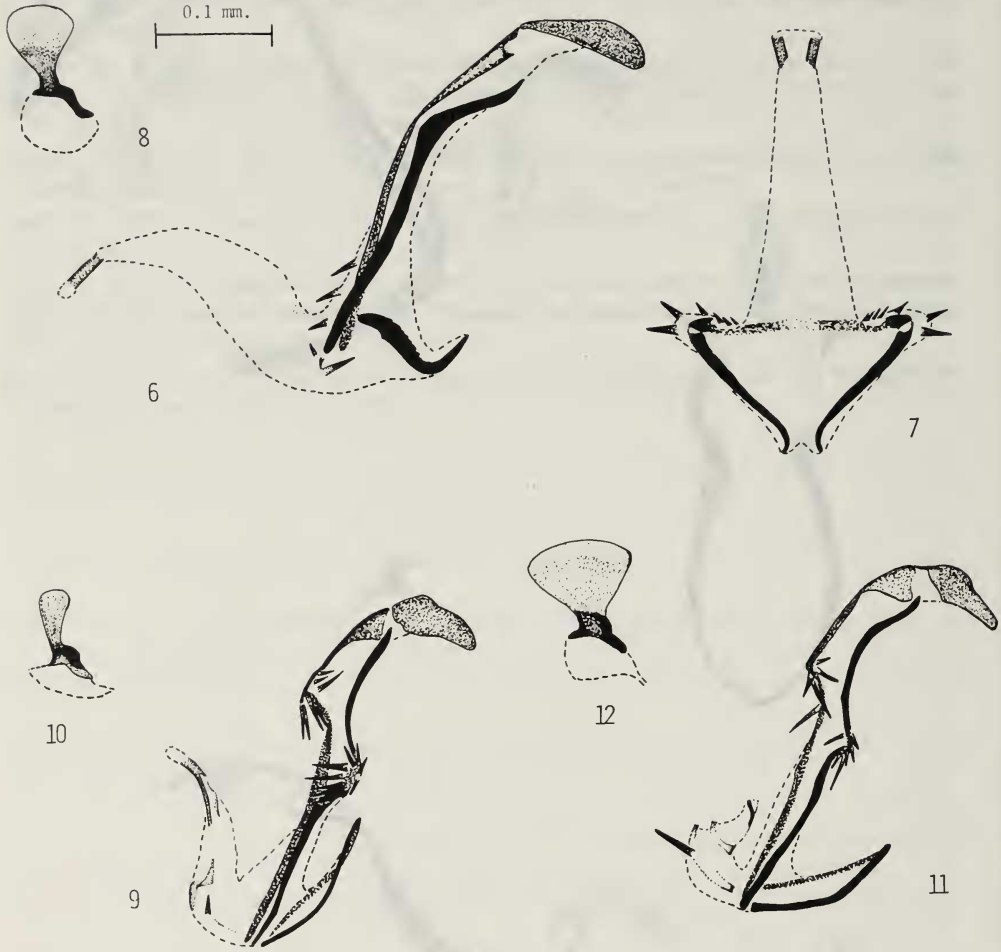

Fig. 6-8. *Phytomyza tussilaginis* Hendel (♂), England: 6, aedeagus in lateral view; 7, distal section and medial lobe of aedeagus in ± ventral view; 8, ejaculatory apodeme. Fig. 9-10. *Phytomyza ravasternopleuralis* Sasakawa (♂): 9, aedeagus in lateral view; 10, ejaculatory apodeme. Fig. 11-12. *Phytomyza senecionis* Kaltenbach (♂): 11, aedeagus in lateral view; 12, ejaculatory apodeme.

Fig. 13-14. *Phytomyza senecionella* Sehgal (♂). Alaska: 13, aedeagus in lateral view; 14, ejaculatory apodeme. Fig. 15-16. *Phytomyza buhriella* Spencer (♂): 15, aedeagus in lateral view (after Spencer, 1969a, slightly modified); 16, ejaculatory apodeme. Fig. 17-19. *Phytomyza lugentis* n. sp., holotype ♂: 17, aedeagus in lateral view; 18, distiphallus in ventral view; 19, ejaculatory apodeme.

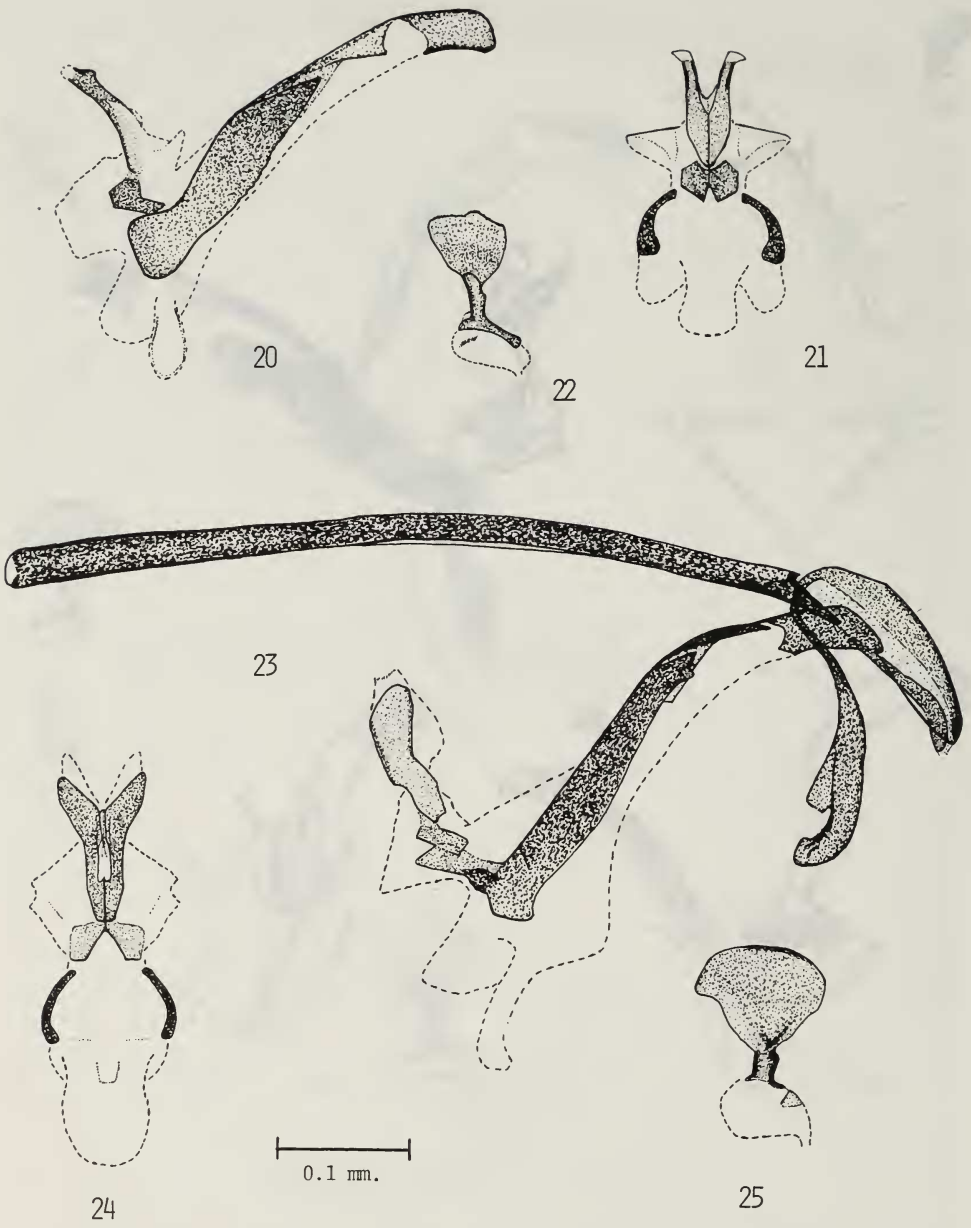

Fig. 20-22. *Phytomyza farfarae* Hendel (♂), Tirol, Austria: 20, aedeagus in lateral view; 21, distal section and medial lobe of aedeagus in anteroventral view; 22, ejaculatory apodeme. Fig. 23-25. *Phytomyza hypophylla* n. sp., holotype ♂: 23, aedeagus and associated structures in lateral view; 24, distal section and medial lobe of aedeagus in anteroventral view; 25, ejaculatory apodeme.

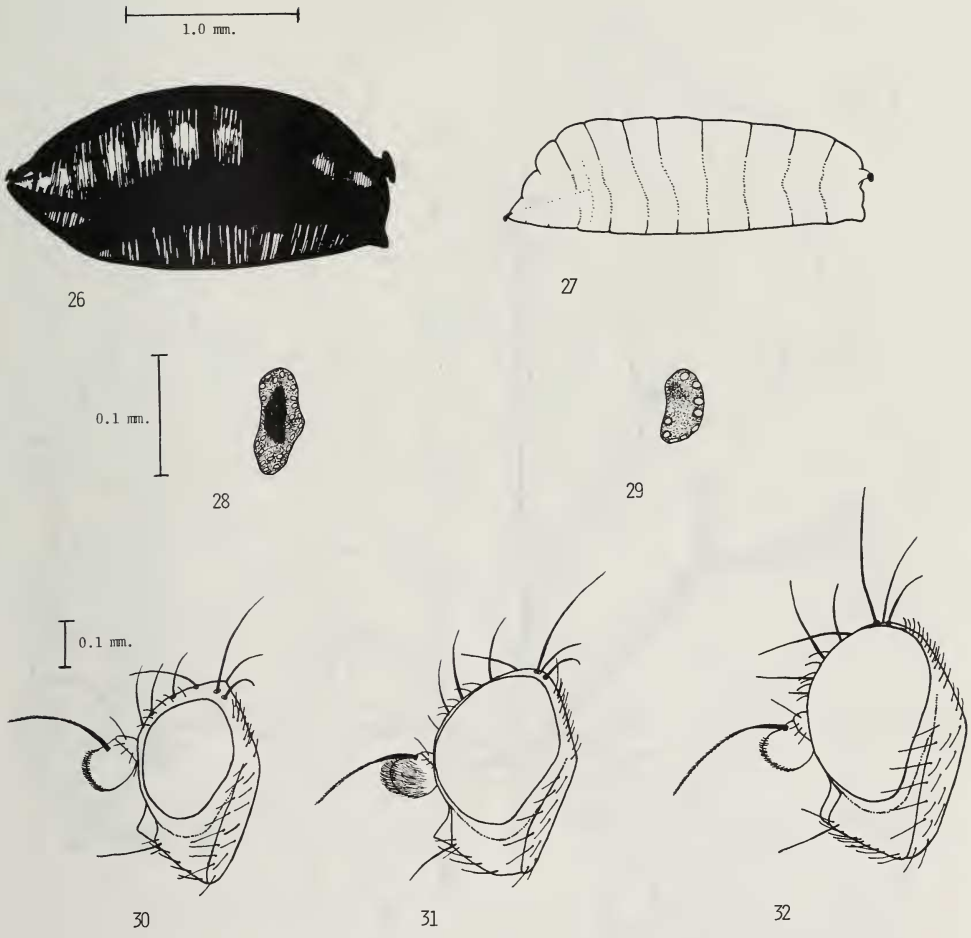

Fig. 26. *Phytomyza tussilaginis* Hendel, puparium in lateral view. Fig. 27. *Phytomyza hypophylla* n. sp., puparium in lateral view. Fig. 28. *Phytomyza alpina* Groschke, posterior spiracle of puparium in caudal view. Fig. 29. *Phytomyza hypophylla* n. sp., posterior spiracle of puparium in caudal view. Fig. 30. *Phytomyza hypophylla* n. sp., head in left lateral view. Fig. 31. *Phytomyza hyperborea* n. sp. (holotype ♀), head in left lateral view. Fig. 32. *Phytomyza alpina* Groschke, head in left lateral view.

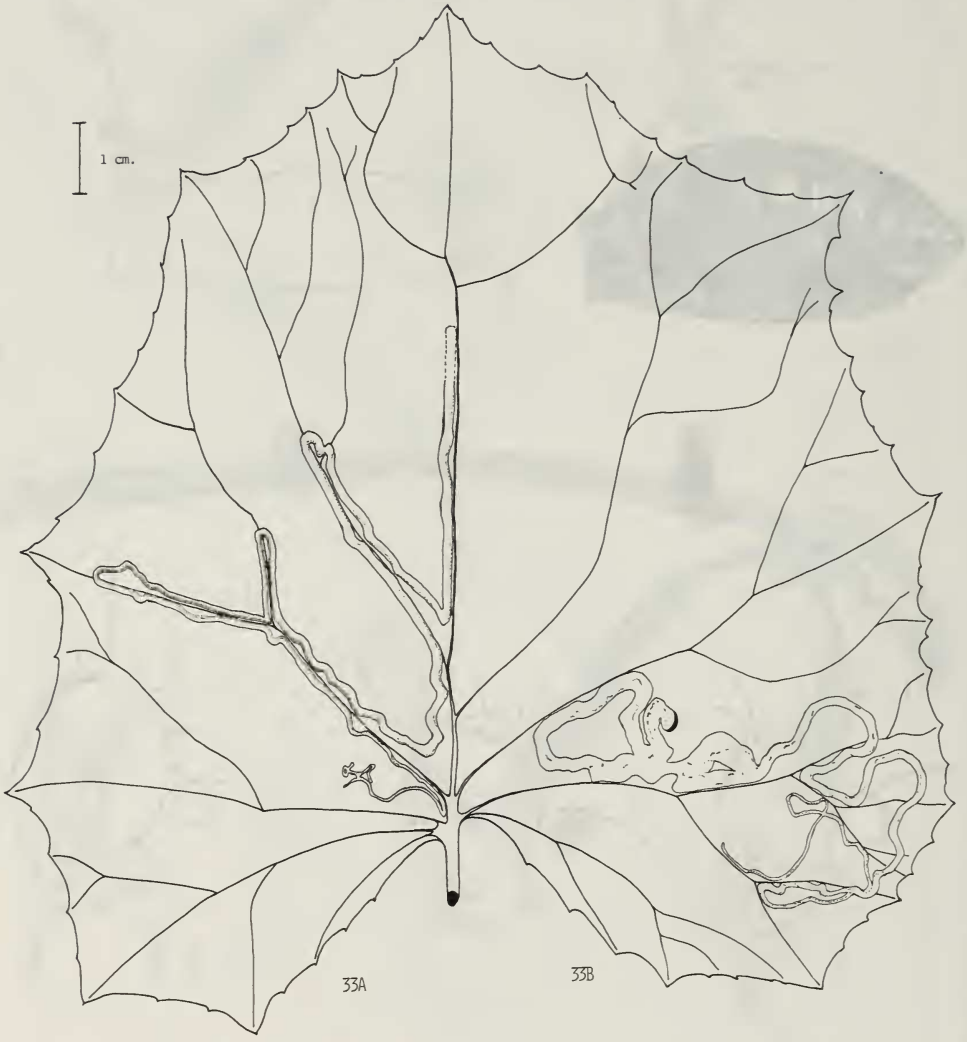

Fig. 33. Leaf of *Tussilago farfara* L. with mines of *Phytomyza farfarae* Hendel (A) and *P. tussilaginis* Hendel (B).

Fig. 34. Leaf of *Petasites hyperboreus* Rydb. (lower surface), with mine of *Phytomyza hypophylla* n. sp.

Fig. 35-36. Leaf mines of *Phytomyza alpina* Groschke: 35, on *Senecio lugens* Richards (Canada); 36, on *Senecio jacobaea* L. (England). Fig. 37. Leaf mine of *Phytomyza senecionis* Kaltenbach on *Senecio nemorensis* L.

Fig. 38. Collection sites for *Phytomyza tussilaginis* Hendel (■ ssp. *tussilaginis*; ● ssp. *petasiti*; ▲ ssp. *kevani*). Fig. 39. Collection sites for *Phytomyza alpina* Groschke.